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# **Grid Marketing and Beef Carcass Quality: A Discussion of Issues and Trends**

by

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Economics Staff Paper No 2008-3  
June 2008

## **Abstract**

Beef industry data suggest that improvements in carcass yield and quality grades have stagnated recently. Empirical analysis, based on USDA market reports, indicates that the share of steer slaughter volume marketed on a grid is less than industry estimates and the growth in market share has stagnated.

Trend analysis of market share suggests that grid pricing has become an important marketing channel, but has not become the dominant marketing channel. The lack of industry progress toward achieving the carcass quality goals suggests that grid pricing has not captured the level of market share needed to realize the goals envisioned for it as a value based marketing system.

**Key words:** Grid Pricing, National Beef Quality Audit, Public Livestock Price Reporting, Beef Carcass Quality

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## **PREFACE**

An early version of this paper was published as a departmental working paper (The Efficacy of the Grid Marketing Channel: SDSU Economics Staff Paper No. 2008-02) in January of 2008. We decided to release an updated version of the paper because comments on the early version indicated that a discussion of grid sales in the contract market needed to be addressed in the earlier version and the absence of this discussion was a major flaw in the original paper. As a result of these comments we incorporated a discussion and analysis of forward and formula sales, and extend the data to January of 2008.

# **Grid Marketing and Beef Carcass Quality: A Discussion of Issues and Trends**

## **Introduction**

The phrase “value based marketing” generally refers to a marketing system that establishes the true market value of a product, based on product characteristics. The Beef Industry’s perceived need for a value based marketing system for slaughter cattle was articulated in the National Cattlemen’s Beef Association (NCBA 1990) white paper War on Fat. The beef industry’s motivation for embracing the concept of value based marketing in the early 1990s was its desire to improve beef’s competitive position in the red meat industry and reverse the dramatic decline in beef demand from 1979 to 1998 (Purcell 1998).

The decline in beef demand during the last two decades of the 21<sup>st</sup> century was dramatic. Based on the Kansas State University Annual Choice Retail Beef Demand Index as an indicator for national beef demand, retail beef demand declined by approximately 50% during the 1979-1998 period, with most of the decline occurring in the 1980s (Mintert 2007). The decline in retail beef demand had a number of negative consequences for the beef industry: a) a 33% loss in market share to poultry and pork, b) dramatic decline in the national beef cow herd, and c) large numbers of producers exiting the industry (Purcell 1998).

The *de facto* value based marketing system for fed cattle is referred to as “grid pricing.” The goal of grid pricing is to provide the market with a pricing mechanism that overcomes inefficiencies associated with selling cattle by the pen (live-weight or dressed-weight) at an average price per hundred cwt. The marketing method of average pricing generates pricing inefficiency because above-average and below-average cattle in a pen

receive the same price per cwt. Average pricing distorts the transmission of market information to producers about the true market value of carcass attributes. This distortion contributes to production inefficiencies that result in inconsistent product quality, failure to provide consumers with beef products having a level of quality they demand, and excess fat production. Thus, average pricing distorts market signals and poses "... a barrier to the transmission of consumer preferences for a particular type of beef product to the fed cattle producer..." (Fausti, Feuz, and Wagner 1998, p.74).

The first publication to empirically evaluate grid pricing appeared in 1998 (Fausti, Feuz, and Wagner 1998). Subsequently, numerous research reports and journal articles have been published which focus on investigating the economic implications of grid pricing as an important marketing channel for fed cattle. However, as Johnson and Ward (2005, p.578) correctly point out, "Economists have conducted considerable research and created an entire body of literature on grid pricing without really addressing a central issue—the efficacy of grid pricing to accomplish its presumed objectives."

The objective of this research is to evaluate the progress of the grid pricing marketing channel toward achieving the goals associated with a value based marketing system. Our focus is limited to the fed steer component of total weekly fed cattle slaughter. To accomplish this task we examine the recent trends in the market share of steer slaughter sold on a grid, and beef carcass quality.

The paper is divided into 5 sections. Section 2, following the introduction, is devoted to a review and evaluation of grid pricing, grid market share, and beef carcass quality literature. Section 3 covers the data related issues. Specifically, the types of finished cattle transaction and pricing methods reported in the AMS market report series,

and the approach used to glean the number of cattle sold on a grid. In this section we also discuss AMS data on carcass quality. Sections 4 and 5 cover methodology and the empirical results, respectively. The paper concludes with a summary and research recommendations.

## **Literature Review**

### **The Evolution of Grid Pricing for Fed Cattle**

The War on Fat, published by the NCBA, recommended the development of a value based marketing system to address declining beef demand resulting from production and marketing inefficiencies plaguing the industry (Value Based Marketing Task Force 1990). The U.S. beef packing industry began developing prototype grid pricing systems in the early 1990s. These prototype systems expanded carcass premiums and discounts beyond the traditional “Grade & Yield” individual carcass pricing system.<sup>1</sup> One example of a prototype appearing in the literature is the Excel Corporation’s Muscle Scoring System (Feuz, Fausti, and Wagner 1993).

In October 1996, the USDA Agricultural Marketing Service (AMS) began publishing weekly grid premium and discount price reports: National Carcass Premiums and Discounts for Slaughter Steers and Heifers (USDA-AMS). The AMS designed the structure of the weekly report to mirror the premium and discount structure of an additive pricing grid consistent with industry protocols (Fausti et al. 1998). These reports provided the market with weekly industry averages based on information voluntarily provided by the packing industry. The AMS weekly survey collected information on: a) yield-grade and quality-grade premiums and discounts, b) heavy and light weight carcass discounts, and c) discounts for carcass defects, such as injection lesions, dark cutters, etc. (Fausti,

Feuz, and Wagner, 1998). In April of 2001, the Livestock Mandatory Price Reporting Act went into effect and packers were mandated to report grid premium and discount information to the AMS.

### **Academic Literature**

Support for the development of a value based marketing system first appeared in the animal science and meat science literature (Thonney 1990, Cross and Whittaker 1992, Cross and Savell 1994, and Smith et al. 1995). In the agricultural economics literature, Schroeder et al. (1998) reported results from a survey designed to address issues facing the beef feedlot industry, and recommended a broad research agenda on value based marketing. Johnson and Ward (2005) raised questions concerning the current direction of grid pricing research. Our intention is to explore this issue and add to their discussion on the efficacy of grid pricing and the current direction of grid pricing research.

A careful review of the grid pricing literature reveals that the primary focus of the literature has been on pricing efficiency. The standard methodology employed by most researchers is to determine individual carcass value under grid based pricing methods and compare these with the average pricing methods at the pen level. Common issues addressed in this literature are: a) average per head revenue differentials, b) average per head profit differentials, c) variability of per head revenue and profit, and d) the role carcass characteristics play in determining the individual carcass value.

This particular methodology was developed in a series of papers dealing with transaction price efficiency in the cash market for slaughter cattle (Feuz, Fausti, and Wagner 1993, 1995; Fausti and Feuz 1995). This earlier research established that average pricing was inefficient relative to an individual carcass based pricing system, but carcass

based pricing was a riskier marketing alternative. These studies also concluded that: a) average pricing distorts the transmission of market signals from consumers to producers, and b) risk aversion on the part sellers and incomplete information about live animal carcass quality characteristics were the main reasons for the coexistence of individual and pen level carcass pricing methods.

Fausti, Feuz, and Wagner (1998) provided the first empirical evaluation of the economic implications of selling on a grid. Their discussion included a literature review outlining the linkages between the decline in beef demand and the introduction of grid pricing. They then provided the first analysis to investigate the economic incentives associated with an additive grid for slaughter cattle. Consistent with their earlier work, they showed that the individual carcass based pricing is a riskier marketing alternative compared to the average pricing if producers are uncertain about the quality of the cattle they are selling. They concluded that this additional risk could be a barrier to widespread adoption of grid pricing in the cattle feeding industry.

A brief overview of the grid pricing literature is provided in Table 1. A number of common threads appear in this literature concerning the attributes associated with the grid pricing marketing alternative. All of these studies focused on price efficiency. A majority of these studies compared a grid to average pricing alternatives. The consensus of these studies is that selling cattle on a grid alternative, compared to the average alternative, does increase price efficiency as well as the profit (revenue) variability. Grid pricing mechanisms also appear to have a discount bias, and premiums have a significant positive effect on profit only in case of high quality cattle. Studies comparing multiple grids or utilizing time series data show that pricing signals vary across grids and over



time. This variability seems to be the result of: a) premium and discount structure determining the manner in which the grid rewards the quality- and yield-grade attributes, b) grid base price selection, c) seasonality, and d) local market conditions at the plant level.

### **Grid Market Share**

It is our view that the efficacy issue discussed in the grid pricing literature refers to whether the grid pricing marketing channel is achieving the goals envisioned for it as a value based marketing system for slaughter cattle. The general consensus in the literature is that the primary goal is improved product quality. To achieve this goal widespread adoption is necessary.

The views expressed in the grid pricing literature on progress made toward achieving widespread adoption are mixed. Several studies suggest that grid pricing (relative to average pricing) leads to increased price variability and a bias for discounts which may act as “barrier to adoption” for many producers (Fausti et al. 1998, Feuz 1999, Anderson and Zeuli 2001, Fausti and Qasmi 2002). Other researchers conclude that grid pricing is gaining market share and providing the proper incentives to meet the goals of a value based marketing system for the cattle industry (Schroeder et al. 2002, McDonald and Schroeder 2003).

Schroeder et al. (2002) conducted a regional feedlot survey covering Iowa, Nebraska, Kansas, and Texas. Their survey results indicate that 16% of cattle marketed by these feedlots were sold on a grid in 1996 and 45% in 2001. They report that feedlot operators indicated that they expected future grid market sales to increase and reach 62% of total sales by 2006. Cattle-Fax®, a private beef consulting firm, estimates that grid

pricing currently accounts for 50% of finished slaughter cattle (Cattle-Fax/Grid-Max website, Aug 2007). Both academic and private industry publications have cited these statistics to show a rapid increase in grid market share of total fed cattle slaughter, e.g., Gelbvieh World (2004) and Smith (2005).

Cited empirical estimates provided by both academic and industry sources suggest that grid pricing has gained market share of total slaughter over the last ten years and will become the dominant marketing mechanism for fed cattle in the near future. The positive trend in market share implies that pricing inefficiency in the fed cattle market should be declining and the industry should be experiencing an increase in average carcass quality.

On the other hand, a recently reported study published by the Livestock Marketing Information Center indicates that grid pricing has not become the dominant marketing channel (Taylor et al. 2007). According to these estimates<sup>2</sup>, the slaughter cattle sold on a grid and average pricing accounted for 43%, and 52%, respectively, during the 2002-2005 period. These findings suggest that the grid pricing has not become the dominant marketing channel for slaughter cattle market.

### **Beef Carcass Quality**

Based on an industry survey, the 2005 National Beef Quality Audit (2005 NBQA) reported that the percentage of cattle grading prime or choice has increased from 58.7% in 1995 to 68.2% in 2004 (NCBA 2006: Table 15). However, the audit noted that the industry is still struggling with the quality and marketing issues that plagued the industry in the 1980s (Value Based Marketing Task Force 1990). The 2005 NBQA specifically raised concerns regarding: a) excess fat production, b) inconsistent meat quality, c) the need for clearer market signals, and d) inconsistent carcass quality (Harpster 2007).

Included in the 2005 NBQA report are USDA estimates for carcass yield and quality (NCBA 2006: Tables 12-13). The 2004 USDA estimate for the percentage of cattle grading either prime or choice is 60.5%, which is almost 8% less than the industry response estimate for the year. USDA also reported an increase in Yield-Grade 4&5 carcasses, from 7.6% in 1995 to 13.1% in 2004. Recent independent research also raises questions about the trend in beef quality. In a recent study released by Certified Angus Beef<sup>TM</sup>, Corah and McCully (2006) report that the percentage of heifers and steers grading prime or choice declined from 58% to 54% and 48% to 44%, respectively. Their findings are based on data collected from 1999 to 2005 on approximately 19.8 million carcasses.

This apparent stagnation in overall carcass quality of fed cattle in recent years, while the industry believes that grid marketing has become the dominant marketing channel for slaughter cattle is a conundrum. Our review of the literature supports the efficacy issue raised by Johnson and Ward (2005). The discussion now shifts to analysis of trends in grid market share and carcass quality and the implications for the industry's goal of transitioning to a value based marketing system for slaughter cattle.

## **Data**

### **Marketing Channel Options for Fed Cattle**

To understand the role of grid pricing in the market for fed cattle, it is necessary to discuss the marketing channel alternatives for finished cattle. Producers can sell fed cattle in the cash (spot) market or on contract for future delivery. The cash market alternatives are auction sales and direct sales to packers. The cash market sales are often referred to as negotiated sales. The contract market alternatives are forward contracts and

formula pricing (also referred to as marketing or supply agreements). Procurement volume across these alternatives varies over time. Ward (2005) reported that over a three-year period (2001-2003), negotiated sales and formula pricing accounted for 46.1% and 43.3% of the total slaughter volume, respectively. Packer ownership, forward contracts, and auction sales account for the residual.

The AMS defines a cash market grid transaction as a negotiated sale for delivery within a 14 days and accordingly reports as a cash (or spot) market transaction. There is general agreement among livestock economists that forward contract transactions are conducted at the pen level at an average price per cwt. There are two types of formula sales; live-weight and dressed-weight formula sales. Livestock economists generally agree that the formula live-weight sales are pen level transactions at an average price per cwt.; however, live-weight sales may have an average pen quality price incentive. Dressed-weight formula transactions are predominantly individual carcass grid based sales, however, a small proportion of these transactions do occur at the pen level.

The passage of the Livestock Mandatory Price Reporting Act in 1999 enabled the AMS to gather and provide the market with a wealth of data on contract sales (Diersen 2004). In 2004, the AMS began to publish weekly grid slaughter volume data for fed cattle. These new data sources enable us to analyze the trend in grid market share over time for fed slaughter steers. However, AMS does not collect or publish the data on the proportion of the animals sold on a grid among the animals sold on a dressed-weight basis in the contract marketing channel.

## **AMS Slaughter Steer Volume and Grid Market Volume Data**

The introduction of livestock mandatory price reporting regulations has enabled the AMS to provide weekly reports on the volume of cattle slaughtered which were purchased on contract and spot markets as well as on a negotiated grid. The AMS began providing this information on April 11, 2004, in market report series LM\_CT154, and LM\_CT151. The weekly data from this point until the end of January 2008 were collected (198 weekly observations). We focus our analysis on the slaughter steer market covering approximately 42.75 million head of slaughter steers marketed during this period. Types of finished live cattle transactions and the pricing methods reported in these AMS reports, relevant to this study, are listed in Table 2.

The AMS refers to “negotiated grid net” transactions as those for which the base price is negotiated between the producer and the packer for delivery within 14 days. Packers report the base price and other relevant transaction information as soon as the transaction is agreed upon. The AMS reports this information initially in the LM\_CT154. Once the cattle are delivered to the packer, slaughtered, and the final net price determined (reflecting premiums and discounts), the transaction is again reported to the AMS, and the data are published a second time in the LM\_CT151. Accordingly, the LM\_CT151 provides the most accurate estimate for grid slaughter volume in the cash market for any given week.

After discussions with AMS market reporters at the St. Joseph, Missouri office, we concluded that a reasonable estimate of weekly finished steer market volume and negotiated grid market share of steer slaughter volume can be gleaned from the AMS livestock weekly market reports as follows.

A. Negotiated Live & Dressed Weight Cash. It is a sum of weekly live and dressed weight steers sold by the pen in the cash market. These data are gleaned from the “Domestic Negotiated Cash Prices” section of the LM\_CT154 report. This includes negotiated sales for live FOB, live delivered, dressed FOB and dressed delivered series (items A.1 through A.4 in Table 2).

B. Negotiated Grid Cash. It is weekly cash market slaughter volume sold on grid, and is the sum of “negotiated grid net sales delivered live” and “negotiated grid net sales dressed weight” categories from LM\_CT151 (items B.1 and B.2 in Table 2).

C. Forward Contract. It is the sum of weekly “forward contract net-live weight” and “forward contract net-dressed weight” series from LM\_CT151 (items C.1 and C.2 in Table 2). AMS does not provide any information on the pricing methods on these series. Livestock economist, generally, agree that forward contract transactions are average priced at the pen level. Accordingly, the cattle in this series are assumed to be priced by the pen at an average price.

D. Formula Pricing. It is the sum of weekly “formula pricing - live weight” and “formula pricing - dressed weight” series from LM\_CT151 (items D.1 and D.2 in Table 2). AMS does not provide any information on the pricing methods on these series. Live stock economists, generally, agree that “formula pricing - live weight” are pen level sales at an average price per cwt. There is an agreement among livestock economists, that the preponderance of “formula pricing - dressed weight” steers are individual carcass grid based sales. Accordingly, it is assumed in our discussion that cattle slaughter reflected in the formula pricing - live weight series are purchased at an average price per pen while

cattle reported sold in the formula pricing - dressed weight series are individual carcass grid based sales.

Adding weekly steer slaughter for negotiated live & dresses weight cash, negotiated grid net cash, forward contract net, and formula pricing net provides a good estimate of weekly total steer slaughter (items A+B+C+D in table 2). Weekly cash steer slaughter is obtained by adding the negotiated live & dressed weight cash and negotiated grid net cash series (items A+B in table 2). The estimate for weekly forward contract and formula pricing marketing channels can be obtained by adding forward contract and formula pricing series (items C+D in table 2). Total slaughter through the grid marketing channel can be estimated by adding together the negotiated grid cash and formula pricing dressed weight series (items B+D.2 in table 2). Finally, the market share estimates can be obtained by dividing these series by weekly total steer slaughter (items A+B+C+D in table 2).

The response from the AMS on this approach for estimating the weekly percentage of slaughter volume for negotiated grid cash market is that this would be the most accurate method for estimating this statistic. However, there is one caveat. Since the AMS defines grid transactions as a cash transaction, individual carcass grid transactions occurring in the contract market as a dressed weight formula transaction are not reported by the AMS. Accordingly in order to arrive at an estimate for weekly total grid slaughter volume, we combined *negotiated grid cash* and *formula pricing - dressed weight (grid)* to arrive at an estimate for weekly grid slaughter volume. Our weekly grid slaughter volume estimate is dependent on the assumptions that: a) forward contract transactions do not have an individual carcass grid marketing option; and b) live-weight formula transactions

do not have some type of value based component for determining individual carcass value but instead may have a value pricing mechanism at the pen level. At this time it is not possible to disaggregate contract market transactions into pricing at the pen level versus pricing at the individual carcass level. We believe that assuming all dressed weight formula transactions as grid transactions will most likely result in an upper bound estimate for the proportion of weekly steer slaughter sold on an individual carcass based grid.

### **AMS Carcass Quality Data**

To analyze the trend in carcass quality we selected the National Steer & Heifer Estimated Grading Percent Report (AMS NW\_LS196) published weekly by the USDA-AMS. We focus on Region 7&8 which produces a significant amount of high quality cattle and accounts for well over 50% of total national weekly slaughter. The AMS NW\_LS196 provides information on breakdown of quality and yield grade percentages for cattle slaughter in CO, IA, KS, MO, MT, NE, ND, SD, UT, and WY. We calculated the weekly percentage of carcasses that yield-graded less than 4 and had a quality grade of at least choice for time period January 1997 through June 2007. This statistic provides a weekly estimate of high quality cattle slaughtered in region 7&8 that did not receive a yield or quality grade discount on a typical pricing grid.

### **Methodology**

#### **Time Series Trend Analysis of AMS Slaughter Cattle Data**

Time series regression techniques were applied to; the cash market grid share of weekly slaughter steers, contract market grid share of weekly slaughter steers, and the



regional carcass quality data to test for the presence of a trend. According to Newbold (1995), the behavior of a time series variable can be broken down conceptually into four categories: a) Trend, b) Seasonal, c) Cyclical, and d) Irregular. We are assuming a time series process which is additive in nature. Assuming that  $X$  is a random variable, and  $X_t$  denotes the value of the series at time  $t$ :

$$1) X_t = \text{Trend}_t + \text{Seasonal}_t + \text{Cyclical}_t + \text{Irregular}_t.$$

The empirical analysis is focused on detecting a trend in the negotiated grid cash market share, formula pricing grid market share, and carcass quality.<sup>3</sup> Standard econometric procedures were applied to remove the deterministic seasonality component.<sup>4</sup> After removing seasonality, series were examined for a unit root using the Phillips-Perron test (Phillips and Ouliaris 1990) and the existence of a unit root was rejected at one percent level. The series plots were then examined and it was determined that all three series exhibited a quadratic trend. Specifically, the regression model was defined as follows,

$$2) X_t = a + b_1 \text{Trend}_t + b_2 \text{Trend}_t^2 + e_t,$$

where  $X$  is the dependent variable,  $t$  denotes time in weeks, Trend and Trend Squared denote the weekly trend and trend squared explanatory variables. The variable  $e_t \sim N(0, \sigma^2)$  denotes the random error term.<sup>5</sup>

## **Empirical Results**

### **Summary Statistics**

Weekly U.S. steer slaughter volume was divided into a number of categories as discussed before. Table 3 provides summary statistics on the cash and contract market slaughter steer volume. The table also provides the estimated proportional contribution to

total weekly steer slaughter volume by the cash, formula, forward contract, and grid marketing channels. Also included in the table are the summary statistics for the percentage of carcasses not subject to yield or quality grade discounts derived from the weekly AMS report for cattle slaughtered in Region 7&8 (544 observations). It may be noted that packer owned cattle are not included in these data.

A. Cash Marketing Channel. Weekly negotiated live and dressed weight slaughter volume varied from 51,455 to 172,354 head, where as negotiated grid net cash slaughter varied from 6,987 to 33,110 head (Table 3). These channels accounted for 49.15 and 8.66 percent, respectively, of total steer slaughter. In the cash market, the combined volume of these two categories, averaged 125,642 head per week and accounted for 57.82 percent of total steer slaughter (Table 3).

B. Contract Marketing Channel. Contract marketing channel has two components, forward contract and formula pricing. Weekly forward contract slaughter varied from 22,638 to 39,855 head with a mean of 10,797 accounting for 5.09 percent of total steer slaughter. Weekly formula pricing of slaughter steers varied from 48,313 to 121,800 head with a mean of 79,291 accounting for 37.08 percent of total steer slaughter. Combining forward contract and formula pricing marketing channels accounted for 42.17 percent of total steer slaughter. Formula pricing has two sub-components, formula pricing live weight, and formula pricing dressed weight (grid). The AMS does not provide data on grid transaction occurring in the formula pricing channel. As stated elsewhere, we assume that all formula pricing live weight are pen level transactions and all formula pricing dressed weight (grid) are individual animal transactions. Weekly dressed-weight formula pricing grid volume varied from 38,459 to 107, 128 head with a

mean of 70,239 accounting for 32.81 percent of total steer slaughter. Given the difficulties in the separating the grid transactions in the formula pricing channel, we believe that our estimate (32.81 percent) is the upper bound of the formula pricing grid market share of total steer slaughter.

C. All Grid Slaughter. As discussed elsewhere, according to our approach, the grid marketing channels consist of: a) negotiated grid net cash, and b) dressed-weight formula pricing. We refer to this aggregate slaughter volume estimate as *all grid slaughter* (cash & formula). Weekly all grid slaughter (cash & formula) varied from 55,923 to 125,195 head, with an average of 88,707 head, accounting for 41.48 percent of total steer slaughter (Table 3). Weekly negotiated grid net cash slaughter averaged 18,467 head accounting for 8.66 percent of total steer slaughter. On the other hand, weekly dressed-weight formula pricing (grid) averaged 70,239 head accounting for 32.81 percent of total steer slaughter (Table 3). Time series plots of the market share of negotiated grid net cash and formula pricing grid are provided in Figures 1 and 2. These plots clearly show quadratic trends. It is quite clear that the negotiated grid net cash market share has been declining steadily. On the other hand, the formula pricing grid market share appears to have peaked in 2007. These trends suggest that growth in grid market share has stalled.

The summary statistics and time series plots suggest that grid market share of steer slaughter is below the expected levels and growth in adoption of grid pricing has stagnated. The smaller share of slaughter attributed to the negotiated, and formula grid transactions revealed in the AMS data, relative to the industry expectations, suggest additional research on this issue is needed.

Table 3 provides insight on the emerging marketing pattern for slaughter steers over the last three years (2004-2007). The dominant marketing channel during this time period seems to be the cash market (negotiated live& dressed, negotiated grid cash) accounting for 57.82 percent of total steer slaughter. During this period, all grid slaughter (cash and contract) steer market accounted for 41.48 percent of total steer slaughter and steers sold by pen accounted for the remaining 58.52 percent of total steer slaughter. Furthermore, steers priced at the pen level accounted for approximately 85.3 percent of steers sold in the cash market compared to 22.2 percent of steers sold in the forward contract and formula market.

Another interesting fact revealed in Table 3 is that the pattern of relative variability of slaughter volume across the marketing alternatives varies. The Coefficient of Variation estimates indicate that while formula pricing has relatively less variability in weekly slaughter volume than the cash market, the cash market has less variability in its share of total weekly slaughter volume. This implies that the weekly market share of steers slaughtered at an average price has been relatively more stable, as a proportion of total slaughter, over time. Finally, the coefficient of variation for total grid slaughter as a proportion of total slaughter exhibits low variability relative to a number of the other marketing channel categories. This suggests the grid market share is relatively stable.

D. High Quality Cattle. As discussed elsewhere, we define a carcass as high quality if it is graded at least Choice and less than Yield Grade 4. Based on ten years of data; the weekly proportion of high quality cattle slaughtered varied from 36.90 to 60.24 percent of total slaughter. The weekly average for the 1997 to 2007 period was 48.71 percent

(Table 3). The summary statistics suggest that there are opportunities for improvement in carcass quality.

### **Trend Analysis**

Initial regression analysis used an ordinary least squares procedure. A test for serial correlation was conducted using the Durbin-Watson procedure. Serial correlation was detected and a Maximum Likelihood autoregressive error correction modeling procedure was selected to correct this problem (SAS 2003). Trend analysis results for grid and high quality carcass market share are provided in Tables 4-6.

A. Cash Grid Market Share. Regression results indicate that there is a statistically significant linear trend in the negotiated grid cash market share (Table 4). Results indicate that this market share has been declining steadily during the period covered in this study. These findings suggest that the negotiated grid cash marketing alternative lacks the momentum necessary to gain a significant share of cash market sales in the future. Given the empirical evidence, it does not appear that the grid marketing channel will become a dominant marketing channel for slaughter steers in the cash market.

B. Contract Grid Market Share. Regression results indicate that there is a statistically significant nonlinear trend in the market share of formula based grid transactions (Table 5). Results indicate that this market share has been increasing at a decreasing rate. Taking the first derivative of the estimated regression equation and then solving for  $x$ , we estimate that the formula based grid market share of slaughter volume peaked in May of 2007. These findings suggest that the slaughter volume associated with formula pricing started losing market share in May of 2007. Nevertheless, formula based grid sales was

the dominant marketing strategy in the contract marketing channel during the period analyzed.

C. High Quality Cattle Share. Regression results show a statistically significant nonlinear trend in the proportion of carcass that grade at least choice and less than YG4 (Table 6). Taking the first derivative of the estimated regression equation with respect to the time-trend variable and setting it to zero indicates that the percentage of cattle slaughtered in Region 7&8 that did not receive a quality or yield grade discount was increasing from 1997 to until mid 2000 and then began to decline. This result is consistent with the literature cited earlier on the apparent stagnation in beef carcass quality in recent years.

### **Summary and Research Recommendations**

We provide an extensive overview of the grid pricing literature, current issues surrounding the quality of beef produced, and industry expectations for the role grid pricing plays as a value based marketing system toward improving beef carcass quality over time. Trend analysis of shares of grid market and high quality cattle indicate a lack of positive progress in recent years. Our grid market share analysis is based on the data previously not available to the public.

Our synthesis of the industry and academic literature indicates that there is a commonly held view that grid pricing has or will become the dominant marketing channel for fed cattle in the near future. The beef industry's expectation is that beef carcass quality will improve as grid market share increases. Recent empirical evidence provided by industry and government sources, however, indicates that beef carcass yield and quality grades have shown little improvement over the last five or six years. Our

trend analysis of the weekly market share of high quality carcasses slaughtered in Region 7&8 is consistent with this literature.

Empirical evidence indicates that approximately 57% of total weekly steer slaughter volume results from spot market sales. On average, cash market grid transactions account for 8.66 percent of total steer slaughter, as reported by the AMS. The contract (forward contract & formula) marketing channel accounted for 42.17 percent of total steer slaughter (Table 3). On an average, steers priced as individual animals accounted for 14.7 percent of steers sold in the cash market and 77.8 percent of steers sold in the forward contract and formula market.

It is our view that grid pricing, as a marketing alternative, has not yet achieved the objectives of a value based marketing system because it has not achieved widespread adoption. To support this conclusion we point to the carcass quality issues highlighted in the NCBA's white paper War on Fat that continues to plague the industry. We believe that research efforts need to focus on why grid market share has stagnated in recent years and to identify barriers to producer adoption of grid pricing before potential modifications to the grid marketing system can be proposed. Until selling cattle by the pen, at an average price, is marginalized by the market, pricing inefficiency will persist and carcass quality issues will continue to plague the industry.

### Footnotes

1. The Grade & Yield pricing system determined carcass value based on dressed weight and the system discounted carcasses that did not achieve quality-grade choice or a yield-grade of less than 4. A grid determined carcass price per cwt. can be determined using an additive process. It should be noted that not all packer grid mechanisms are strictly additive.
2. This estimate is based on data collected during the USDA Grain Inspection, Packers and Stockyard Administration's Livestock and Meat Marketing Study 2007. The data set contains approximately 58 million head sold during the 2002-2005 timeframe.
3. It is not our intent to explain the variability in grid market share or carcass quality in this paper.
4. The seasonal component was removed from the grid market share and carcass quality data by regressing the variables of interest on monthly seasonal dummy variables. The regression residuals embody the deseasonalized data.
5. The variability of the time series cyclical and irregular components will be accounted for in the regression residuals. Preliminary analysis did find a statistically significant seasonality component in the carcass and grid data sets. However, since the focus of the empirical analysis is on trend analysis, and incorporating discussion and tables on the seasonality issue would have greatly lengthened the manuscript, we decided to address the seasonality issue in a forthcoming paper.



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**Table 1: Summary of Grid Pricing Literature**

Author(s) and Year	Obs. Unit Pen or individual animal	Number of grids	Cross sectional or pooled time series data analysis	Marketing channels compared	Number of pens/head	Date of grid pricing data	Variables of interest
Fausti et al. 1998	Individual	one	Cross sectional	Grid vs. dressed weight	2/3,000	Apr-97	Per head Avg. revenue and revenue variability
Feuz 1999	Individual	three	Pooled cross sectional, six marketing dates	Multi grid comparison	85/5,520	Dec 1996 to Feb 1998	Grid premium or discount per cwt. / carcass attributes
Schroeder and Graff 2000	Pen	one	Time series	Grid vs. dressed vs. live	71/11,703	Weekly 1997	Per head Avg. revenue and revenue variability
Anderson and Zeuli 2001	Pen	one	Time series	Grid vs. live	6/500	Oct 1996 to May 2001	Per head Avg. revenue and revenue variability
Fausti and Qasmi 2002	Pen	one	Time series	Grid vs. dressed weight	2/3,000	Jan 1997 to Dec 2000	Average per head price differential (grid – dressed weight); seasonality and trend
McDonald and Schroeder 2003	Pen	two	Pooled cross sectional	Multi grid comparison	4,494 pens	1992-1998	Carcass attributes, production cost effect on profit per head
Johnson and Ward 2005	Individual	one	Cross sectional	None	18,267 heads	Single weekly grid based on two year average for premiums and discounts 1996-1998	Per head grid revenue, carcass attributes affecting revenue variability
Johnson and Ward 2006	Individual	one	Cross sectional	Comparing high quality vs. low quality cattle on single grid	18,267 heads	Single weekly grid based on two year average for premiums and discounts 1996-1998	Per head grid revenue, carcass attributes affecting revenue variability

**Table 2. Finished live cattle markets, pricing methods, data sources, and calculation of market shares**

<b>Market Description</b>	<b>Priced by Pen or Individual Animal</b>	<b>Data Source (AMS Report)</b>
<b>A. Negotiated Live &amp; Dressed Wt. Cash<sup>1</sup></b>		
A.1 Negotiated Sales - Live FOB	by Pen	LM-CT154
A.2 Negotiated Sales - Live Delivered	by Pen	LM-CT154
A.3 Negotiated Sales - Dressed FOB	by Pen	LM-CT154
A.4 Negotiated Sales - Dressed Delivered	by Pen	LM-CT154
<b>B. Negotiated Grid Cash<sup>1</sup></b>		
B.1 Negotiated Grid Net Sales - live Delivered	by Individual Animal	LM-CT151
B.2 Negotiated Grid Net Sales - Dressed Weight	by Individual Animal	LM-CT151
<b>C. Forward Contract<sup>2</sup></b>		
C.1 Forward Contract Net - Live Weight	by Pen <sup>3</sup>	LM-CT151
C.2 Forward Contract Net - Dressed Weight	by Pen <sup>3</sup>	LM-CT151
<b>D. Formula Pricing<sup>2</sup></b>		
D.1 Formula Pricing - Live Weight	by Pen <sup>4</sup>	LM-CT151
D.2 Formula Pricing - Dressed Weight (Grid)	by Individual Animal <sup>5</sup>	LM-CT151
<b>Calculation of Different Market Shares</b>		
Total Steer Slaughter = A+B+C+D		
Cash Market = A + B		
Forward Contract and Formula Market = C+D		
All Grid Slaughter = B + D.2		
Negotiated Live & Dressed Cash Weight Market Share = A / (A+B+C+D)		
Negotiated Grid Cash Market Share = B / (A+B+C+D)		
Cash Market Share = (A + B) / (A+B+C+D)		
Formula Pricing Market Share = D / (A+B+C+D)		
Formula Pricing Grid Market Share = D.2 / (A+B+C+D)		
Forward Contract Market Share = C / (A+B+C+D)		
Forward Contract & Formula Market Share = (C+D) / (A+B+C+D)		
All Grid Slaughter Market Share = (B + D.2) / (A+B+C+D)		

<sup>1</sup>Includes animals to be delivered in 14 days, and excludes auction sales.

<sup>2</sup>Includes animals to be delivered after 14 days, and excludes packer owned cattle.

<sup>3</sup>Assumed as livestock economists generally agree that forward contract transactions are conducted at the pen level at an average price per cwt.

<sup>4</sup>Assumed as livestock economists generally agree that formula live-weight sales are pen level sales at an average price per cwt. but may also have an average pen quality price incentive associated with the transaction.

<sup>5</sup>Assumed as livestock economists generally agree that the preponderance of dressed-weight formula transactions are individual carcass grid based sales.

Table 3. Summary Statistics: Weekly Steer Slaughter, by Types and High Quality Cattle

Variable	Obs.	Mean	Std Dev	Min	Max	Coefficient of Variation
<b><u>Steer Slaughter by Market Type (Numbers)</u></b>						
Total Steer Slaughter	198	215,912	34,082	136,134	295,060	15.78%
Negotiated Live & Dressed Wt. Cash	198	107,174	25,788	51,455	172,354	24.06%
Negotiated Grid Net Cash	198	18,467	5,171	6,987	33,110	28.00%
Cash Market	198	125,642	27,638	60,899	199,189	21.99%
Forward Contract	198	10,797	6,308	22,398	39,855	58.40%
Formula Pricing Net:						
Live wt. plus Dressed wt.	198	79,291	13,337	48,313	121,800	16.82%
Formula Pricing Grid: dressed wt. only	198	70,239	11,982	38,459	107,128	17.05%
Forward Contract & Formula	198	90,270	16,103	54,235	141,793	17.83%
All Grid Slaughter, Cash & Contract	198	88,707	13,137	55,923	125,195	14.81%
<b><u>Steer Slaughter by Market Type (Market Share as % Total Steer Slaughter)</u></b>						
Negotiated Live & Dressed Wt. Cash	198	49.15%	6.38%	25.94%	68.07%	12.98%
Negotiated Grid Net Cash	198	8.66%	2.49%	4.21%	17.22%	28.75%
Cash Market Share	198	57.82%	6.53%	37.69%	74.05%	11.29%
Forward Contract	198	5.09%	2.82%	1.08%	20.22%	55.40%
Formula Pricing Net						
Live wt. plus Dressed wt.	198	37.08%	5.58%	23.85%	54.04%	15.04%
Formula Pricing Grid: dressed wt. only	198	32.81%	4.80%	19.92%	46.70%	14.60%
Forward Contract & Formula	198	42.17%	6.53%	25.95%	62.30%	15.48%
All Grid Slaughter, Cash & Contract	198	41.48%	5.27%	28.80%	57.03%	12.70%
<b><u>High Quality Cattle (Share as % Total Steer Slaughter)</u></b>						
Carcass that grade at least Choice & less than YG4	544	48.71%	4.19%	36.90%	60.24%	8.60%

Table 4: Regression Results for Negotiated Grid Cash Market Share: 2004 to 2008

SSE: 638		Regression $R^2$ : 0.1678		DFE: 193		AIC: 803	
MSE: 3.30		Total $R^2$ : 0.4444		Root MSE: 1.81		SBC: 820	
Variable	DF	Parameter Estimate	Standard Error	t-Value	P-Value		
Intercept	1	2.75	0.68	4.05	0.001		
Time-trend	1	-0.0343	0.0158	-2.17	0.031		
Time-trend Squared	1	0.0000479	0.0000769	0.62	0.534		
AR1	1	-0.2348	0.0688	-3.41	0.008		
AR3	1	-0.2121	0.0693	-3.06	0.025		

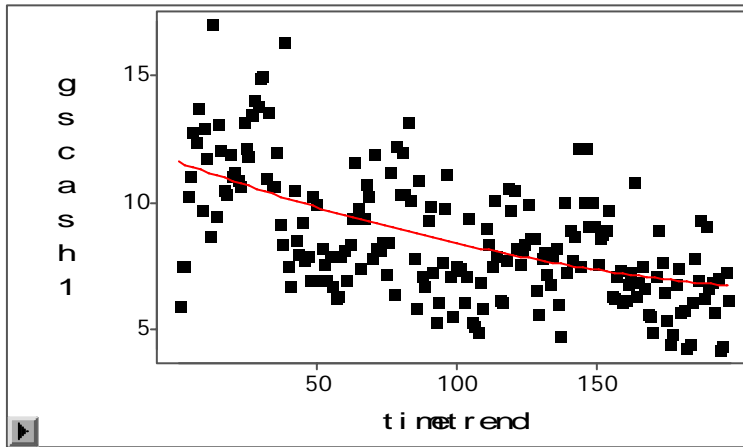
Table 5: Regression Results for Formula Pricing Grid Market Share: 2004 to 2008

SSE: 3434		Regression $R^2$ : 0.093		DFE: 194		AIC: 1134	
MSE: 17.70		Total $R^2$ : 0.1588		Root MSE: 4.20		SBC: 1148	
Variable	DF	Parameter Estimate	Standard Error	t-Value	P-Value		
Intercept	1	-4.009	1.099	-3.65	0.001		
Time-trend	1	0.0677	0.0255	2.65	0.008		
Time-trend Squared	1	-0.000207	0.000124	-1.67	0.001		
AR3	1	-0.190	0.0717	-2.65	0.008		

Table 6: Regression Results for High Quality Carcass Market Share for Region 7 and 8: 1997 to 2007

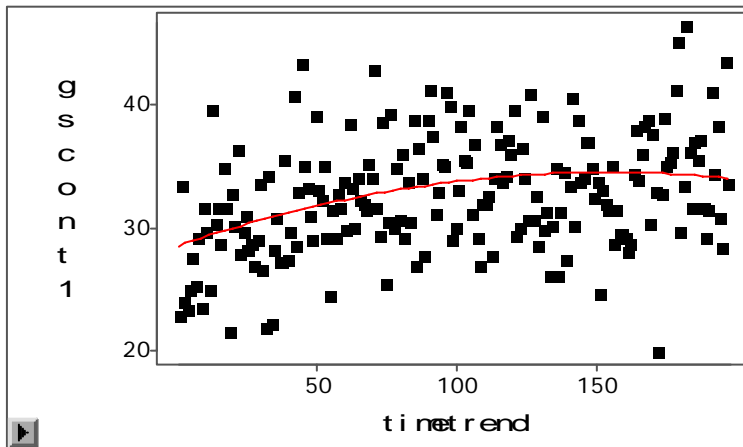
SSE: 856		Regression $R^2$ : 0.1036		DFE: 538		AIC: 1803	
MSE: 1.59		Total $R^2$ : 0.8960		Root MSE: 1.26		SBC: 1829	
Variable	DF	Parameter Estimate	Standard Error	t-Value	P-Value		
Intercept	1	0.6079	1.1414	0.53	0.59		
Time-trend	1	0.0265	0.00965	2.75	0.006		
Time-trend Squared	1	-0.000078	0.000017	-4.55	0.001		
AR1	1	-0.4681	0.0416	-11.26	0.001		
AR2	1	-0.1700	0.0436	-3.90	0.001		
AR4	1	-0.2350	0.0382	-6016	0.001		

Figure 1: Cash Grid Market Share



The vertical axis variable is grid market share in the cash market as proportion of total steer slaughter. The horizontal axis variable is time measured as one week equals one unit.

Figure 2: Contract Grid Market Share



The vertical axis variable is grid market share in the contract market as proportion of total steer slaughter. The horizontal axis variable is time measured as one week equals one unit.